National Energy Board

Office national de l'énergie

FOCUS ON
SAFETY AND ENVIRONMENT

A COMPARATIVE ANALYSIS OF PIPELINE PERFORMANCE 2000-2008

AUGUST 2010

Canada

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Focus on Safety and Environment

A Comparative Analysis of Pipeline Performance

2000–2008

August 2010

Canada

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LIST OF ACRONYMS AND ABBREVIATIONS

CAPP	Canadian Association of Petroleum Producers
CONCAWE	European Oil Companies Association for Environment, Health and Safety
CSA	Canadian Standards Association
EGIG	European Gas Pipeline Incident data Group
ERCB	Energy Resources Conservation Board (formerly Alberta Energy and Utilities Board)
HRSDC	Human Resources and Skills Development Canada
NEB	National Energy Board
NGL	Natural Gas Liquids
OPR-99	Onshore Pipeline Regulations, 1999
PHMSA	Pipeline and Hazardous Materials Safety Administration

FOREWORD

This report, *Focus on Safety and Environment: A Comparative Analysis of Pipeline Performance, 2000-2008*, examines the number and frequency of various incidents that affect pipeline safety, integrity and the environment. The objective of this report is to present safety and environmental performance indicators of NEB-regulated onshore pipelines and to compare the data to that of other jurisdictions.

The first of the NEB's annual performance indicators reports, *Focus on Safety: A Comparative Analysis of Pipeline Safety Performance*, was published in April 2003. This eighth edition of the report includes data from 1 January 2000 through 31 December 2008.

The NEB continually seeks input and feedback from stakeholders on the value of this report and ways it can be improved. Any comments or questions pertaining to this report should be directed to:

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INTRODUCTION

1.1 NEB Safety Role

In 2008 the NEB regulated 104 oil, gas and product pipeline companies that operate approximately 47 000 kilometres of pipelines across Canada under the *National Energy Board Act* and the Onshore Pipeline Regulations, 1999 (OPR-99). This network includes large diameter, small diameter, high-pressure natural gas, crude oil and oil products pipelines, as well as a number of commodity (non-hydrocarbon) pipelines.

The NEB gathers information on performance indicators that relate to safety and environmental impacts through both compulsory reporting on a per incident basis and on an annual voluntary basis, for all pipelines regulated through the OPR-99. The performance indicators reported upon relate to:

- Fatalities;
- Injuries;
- Pipeline ruptures;
- Pipeline contacts;
- Liquid releases, leaks and spills; and
- Gas releases.

The voluntary performance data is normalized on the basis of pipeline length and hours worked, allowing for annual comparisons, as well as comparisons between agencies and other organizations. The NEB compiles this annual report in order to provide a historic trend analysis

1.2 2000 – 2008 Pipeline Performance Indicators

In 2001, the NEB began the Safety Performance Indicator (SPI) Initiative, a voluntary reporting initiative to collect detailed information on injuries, leaks, and spills. The analysis of this voluntarily reported data helps both the NEB and its regulated companies to monitor safety and environmental performance. The information gathered for this report represents data to 31 December 2008. A list of

companies that have voluntarily reported environmental and safety information for 2008 is provided in Appendix One, Pipeline Performance Indicator Data.

In 2008, reporting by pipeline companies showed that several performance indicators have improved since 2007. From a safety perspective, injury frequencies for both contractors and employees have seen a marked decrease in 2008, returning to levels comparable to those reported in 2005 and 2006. However, two fatalities reported in 2008 are cause for major concern. Safety performance indicators are discussed in detail in Chapter 2 of this report.

From an environmental protection perspective no pipebody liquid releases were reported and the number of non-pipeline spills and liquid leaks remained stable. Environmental performance indicators are discussed in detail in Chapter 3 of this report.

For the purpose of evaluating pipeline construction, operation and maintenance performance, the term "pipeline" includes: all branches, extensions, tanks, reservoirs, storage facilities, pipes, pumps, valves, racks, compressors and loading facilities integral to the operation of a hydrocarbon pipeline.

1.3 Reference Organizations

Where comparable data is available, the NEB conducts a comparative analysis of performance indicators with that of other agencies. This external data is based on publicly available documents provided on websites and in published reports. The following organizations have been selected for comparison in this report:

- CAPP: Canadian Association of Petroleum Producers; www.capp.ca
- CONCAWE: Conservation of Clean Air and Water in Europe; European Oil Companies Association for Environment, Health and Safety; www.concawe.be
- EGIG: European Gas Pipeline Incident Data Group; www.egig.nl
- ERCB: Alberta Energy Resources Conservation Board; www.ercb.ca
- HRSDC: Human Resources and Skills Development Canada; www.hrsdc.gc.ca
- PHMSA: United States Department of Transportation – Pipeline and Hazardous Materials Safety Administration - Office of Pipeline Safety; http://phmsa.dot.gov

PIPELINE SAFETY PERFORMANCE

The NEB recognizes the efforts regulated companies and their contractors make to operate safe workplaces in order to prevent fatalities and injuries. That being said, the nature of the industry and the number of persons working within it pose a continuous risk. In order to reduce risk to the public and workers, proactive safety management and a culture of safety must be values and priorities for industry.

2.1 Pipeline Fatalities

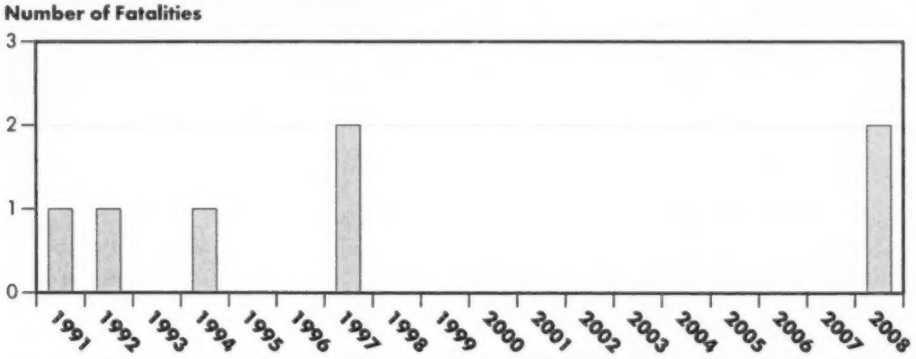
Fatality data provided by NEB-regulated pipeline companies are evaluated to determine if the incident involved employees, contractors or members of the public and whether it involved activities related to the construction, operation or maintenance of pipelines.

Figure 2.1 shows the number of reported fatalities on NEB-regulated pipelines between 1991 and 2008. All fatalities reported between 1991 and 1997 involved contract workers conducting construction activities. There followed ten consecutive years in which there were no work-related fatalities on NEB-regulated pipelines, though several thousand kilometres of new pipelines were constructed and existing pipelines expanded during that period. Two fatalities were reported for 2008; one involved a contractor conducting construction activities, while the second involved an employee performing an operation and maintenance activity.

On 24 March 2008, near Kerrobert, Saskatchewan, an electrician employed by a pipeline company died while working with high voltage electricity. The investigation has concluded and the details are available on the NEB website.

FIGURE 2.1

Fatalities on NEB-Regulated Pipelines



The root causes of the incident include:

- Inappropriate risk categorization of the hazards associated with the job.
- Lack of understanding and inconsistent application of the hazard assessment, safe work permit and task analysis procedures.
- Internal company forms not consistently applied or clearly understood by the workers.
- A lack of safety culture and awareness among the workers involved.
- Weaknesses in the safety training program provided to the workers involved in this incident.
- Inconsistent knowledge and practice among workers involved in this incident on the required personal protective equipment for electrical work.

On 24 June 2008, an employee of a contractor working for a NEB-regulated company left the worksite in a company vehicle for a town of Biggar, SK sometime between 4:00 & 4:30 p.m. to pick up parts required to complete an equipment repair.

Approximately 45 minutes after the employee left the site, the vehicle went off the road.

2.2 Injuries

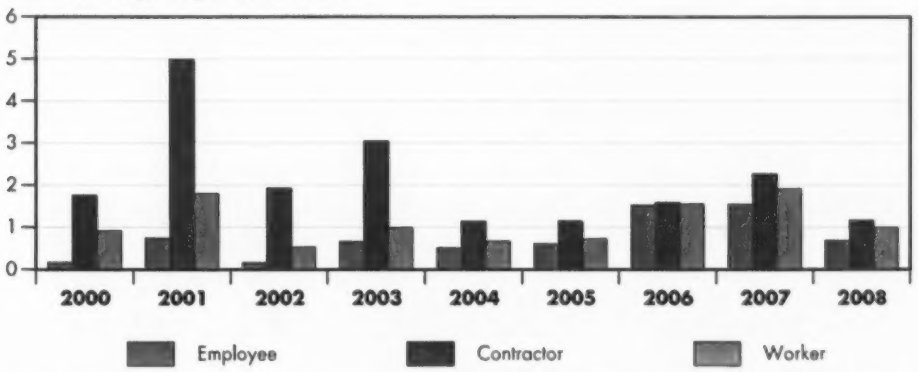
Frequency data for injuries is reported through a combination of mandatory reporting under the OPR-99 and voluntary reporting under the SPI initiative; as such it includes all lost time and restricted workday injuries, but excludes fatalities. For this report, injury data submitted by NEB-regulated companies have been separated into three catagories:

1. Employee Injuries
   These are injuries that occur while an employee is involved in activities associated with their job duties. Employee data from NEB-regulated pipelines do not include head office staff but do include staff from other facility offices.
2. Contractor Injuries
   These are injuries that occur while a contract worker is involved in activities pursuant to their contract with a pipeline company. Contractor data include contractors performing activities related to the construction, operation, or maintenance of NEB-regulated pipelines.

FIGURE 2.2

Injury Frequency

Number of injuries per 200,000 hrs



3. Worker Injuries
   These are a combination of the above two categories: employee and contractor injuries.

These data are shown in Figure 2.2. All injury frequencies are measured in terms of injuries per 200 000 hours of work. Work based on 200 000 hours is widely used in the health and safety industry and is equivalent to the number of hours worked by 100 full-time employees in one year. Worker injury frequency decreased from 1.9 injuries per 200 000 hours in 2007 to 1.0 in 2008.

2008 was a heavy construction year for the pipeline industry, with employees and contractors working nearly four times as many hours as were worked in 2007. The Board notes that the frequency of injuries showed a significant decrease in 2008. However, the Board remains concerned about the number of injuries sustained by workers in the pipeline industry and would like to highlight the importance of further improvement. A summary of employee and contractor hours and the number of injuries incurred since 2000 is provided in Appendix One Pipeline Performance Indicator Data.

2.3 Detailed Injury Analysis

To better understand reported injury frequencies, data has been separated by contractor and employee and by type of pipeline. In addition, contractor serious injury types and causes, as well as non-compliances observed by the NEB on construction projects have been evaluated.

NEB-Regulated Liquid Pipeline Injuries

Liquid pipelines include crude oil, refined product and NGL pipelines. Contractor, employee and worker injury frequencies for NEB-regulated liquid pipelines are shown in Figure 2.3. It is of note that no contractor or employee injuries were reported in 2002.

The contractor injury frequency has historically been higher than that of company employees, increasing steadily from 2004 through 2007; this trend did not continue in 2008. The employee injury frequency for liquid pipelines has been relatively low for the past seven years; however there was a recent increase from 0.4 in 2007 to 0.5 in 2008. The contractor injury frequency of 1.4 injuries per 200 000 hours for liquid pipelines in 2008 represents a reduction of 43 percent over the 2007 results and a reduction of 57 percent over the 9 year average of 3.5.

FIGURE 2.3

Liquid Pipeline Injury Frequency

Number of injuries per 200 000 hrs

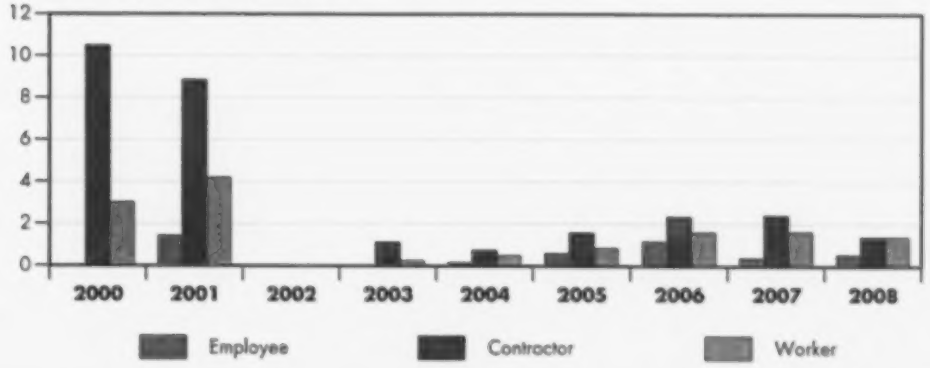
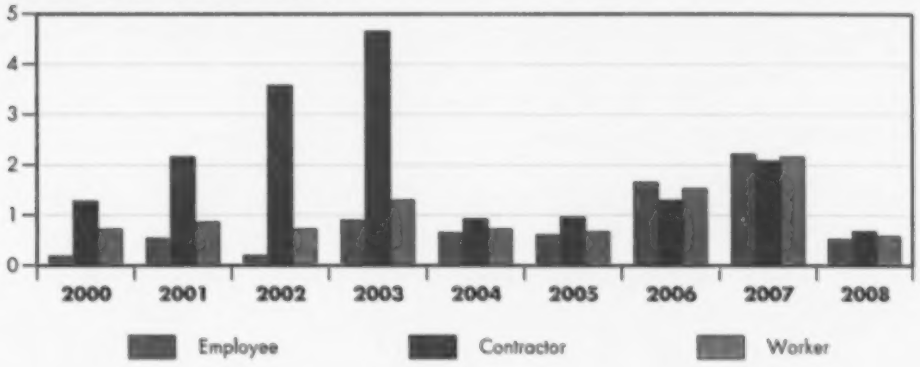


FIGURE 2.4

Gas Pipeline Injury Frequency

Number of injuries per 200 000 hrs



NEB-Regulated Gas Pipeline Injuries

Gas pipelines include natural gas, both sweet and sour and high vapour pressure product pipelines. The injury frequency for all workers including contractors and employees for NEB-regulated gas pipelines is shown in Figure 2.4.

The gas pipeline employee and contractor injury frequency decreased significantly in 2008. Employee injuries fell 76 percent from 2.2 in 2007 to 0.5 in 2008. Contractor injuries fell from 2.1 in 2007 to 0.7; a 67 percent reduction.

Employee Injury Frequency Comparisons

NEB-regulated pipeline employee injury frequency is compared to reference organizations, Human Resources and Social Development Canada (HRSDC) and the Canadian Association of Petroleum Producers (CAPP) for the period 2000 to 2008 in Figure 2.5. NEB-regulated pipeline companies show a marked increase in the number of employee injuries between 2005 and 2007, while the CAPP frequency decreased. In 2008, the employee injury frequency fell by 56 percent; this reduction to 0.68 is now more consistent with the reported CAPP frequency of 0.64.

FIGURE 2.5

Employee Injury Frequency

Number of Injuries per 200 000 hours

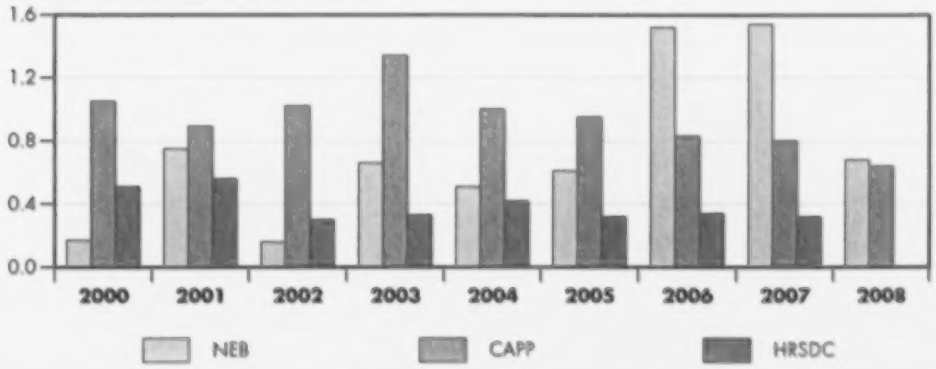
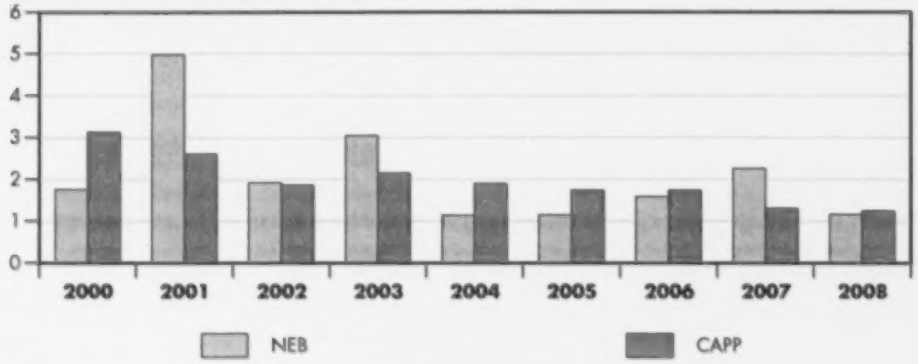


FIGURE 2.6

Contractor Injury Frequency

Number of Injuries per 200 000 hours



HRSDC publishes employee injury frequency data, which includes disabling injuries to employees, both in the field and working in head and regional offices for all federally regulated workplaces. NEB-regulated pipeline employee injury data does not include head offices. The HRSDC pipeline employee injury frequency for 2000 to 2007 ranged from 0.3 to 0.6 injuries per 200 000 hours. HRSDC data was not available for 2008 at the time of this comparison.

Contractor Injury Frequency Comparisons

A comparison of contractor injury frequency relative to CAPP data for the period of 2000 through 2008 in Figure 2.6 shows that NEB-regulated pipeline injury frequencies were on average similar to those reported by CAPP. The NEB nine-year average indicates that approximately 2 out of 100 full time contractor workers were injured every year.

Contractor Serious Injuries

The types of serious injuries incurred by contracted workers on NEB-regulated pipelines and reported between 2000 and 2008 have been categorized in Table 2.1. Serious injury is defined as an injury that results in: the fracture of a major bone; the amputation of a body part; the loss of sight in one or both eyes; internal haemorrhage; third degree burns; unconsciousness; or the loss of function of a body part. Note that no serious injuries were reported in 2002. In 2008 two serious injuries were reported.

The NEB has conducted further analysis on the causes of these incidents as shown

TABLE 2.1

Cumulative Serious Injuries 2000 – 2008

Type of Event or Exposure	Number of Serious Injuries
Contact with Objects & Equipment	
Struck by Object	8
Caught in Object	4
Struck against Object	1
Contact with Electricity	2
Other	0
Falls	
Fall on Same Level	0
Fall to Lower Level	2
Other	0
Transportation Accidents	1
Fire and Explosions	0
Total Number of Serious Injuries	18

TABLE 2.2

Contractor Serious Injury Causes 2000 – 2008

Direct Causes		2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Substandard Acts	Improper position for task		1			1					2
	Improper placement	1	1		1			1		1	5
	Using equipment improperly		1				1				2
	Failure to warn	1									1
	Failure to secure				1				2	1	4
	Failure to follow procedures						1				1
Substandard Conditions	Hazardous environmental conditions						1				1
	Inadequate sign or label					1					1
Total Injuries		**2**	**3**	**0**	**2**	**2**	**3**	**1**	**2**	**2**	**17**
	Basic Causes										
Job Factors	Inadequate leadership/supervision	1	2								3
	Inadequate tools and equipment				1				1	1	3
	Inadequate work standards				1	1					2
	Inadequate engineering						1		1		2
Personal Factors	Poor Judgment		1				1	1			3
	Lack of knowledge						1			1	2
	Improper motivation	1				1					2
Total Injuries		**2**	**3**	**0**	**2**	**2**	**3**	**1**	**2**	**2**	**17**

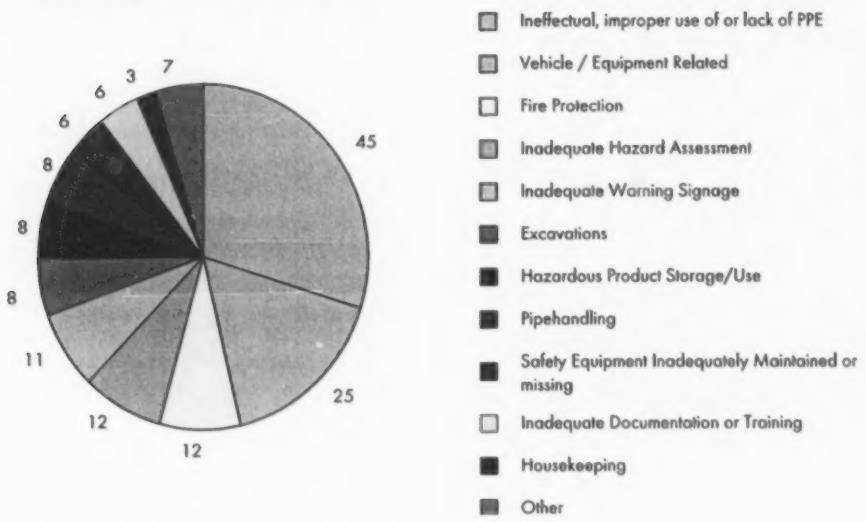
in Table 2.2. The NEB has noted that the contractor injury frequency is, on average, higher than that of employees. While the hazard exposure may be greater for contractors, preventative measures such as hazard assessments, proactive safety management programs and worker education should be designed to reduce any increased risk.

2.4 Construction Safety Inspections

As part of its activities to monitor compliance with the OPR-99, safety regulations and associated technical standards, the NEB regularly inspects pipeline construction projects. Should contraventions of the CLC and OPR-99 be noted during observed during inspecitions, they are often corrected immediately onsite. They are recorded and tracked so that the NEB and Industry may pay special attention to areas of concern. This allows the NEB and its regulated companies to apply a predictive approach to incident prevention and overall safety management. The results of NEB safety inspections in 2008 are shown in Figure 2.7.

FIGURE 2.7

2008 NEB Pipeline Safety Inspections



2.5 Pipeline Ruptures

Ruptures are defined as a "loss of containment event that immediately impairs the operation of a pipeline". Pipeline ruptures have the potential to be severely detrimental to the environment and to public and worker safety. Pipeline ruptures are always investigated to determine their primary cause. The number of NEB-regulated pipeline ruptures and their primary cause since 1991 are shown in Figure 2.8 These data are considered both safety and environmental performance indicators.

Between 1991 and 2002, there was an average of 2.5 ruptures per year. In 1999, companies were required under the OPR-99 to have pipeline integrity management programs. The proactive nature and the evolution of individual company integrity management programs may be responsible in part, for the decline in ruptures since 2002. However, in 2007 there were two ruptures on liquid pipelines. One rupture occurred when a third party struck a crude oil pipeline. The other rupture was caused by cracking due to fatigue. There were no ruptures reported in 2008.

FIGURE 2.8

NEB-Regulated Pipeline Ruptures 1991 – 2008

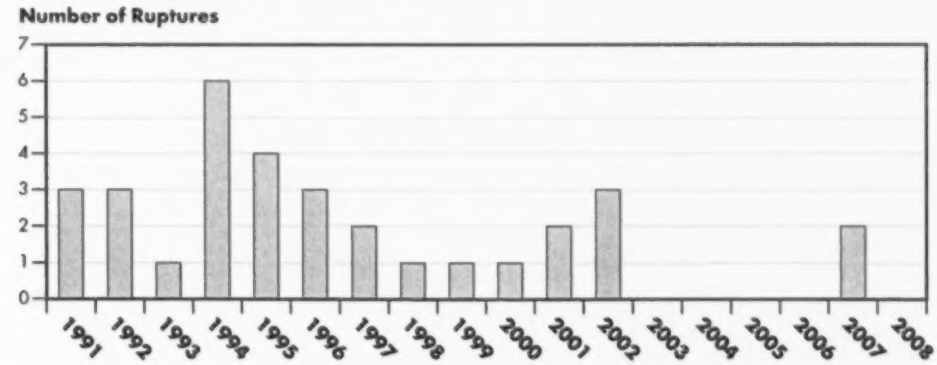


FIGURE 2.9

NEB-Regulated Pipeline Rupture Causes

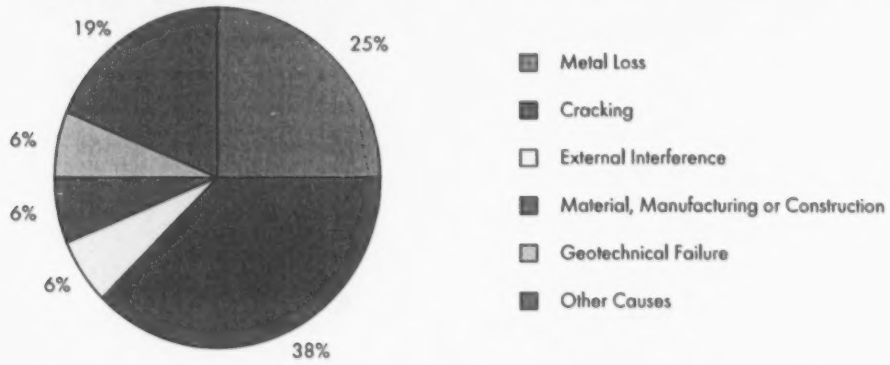
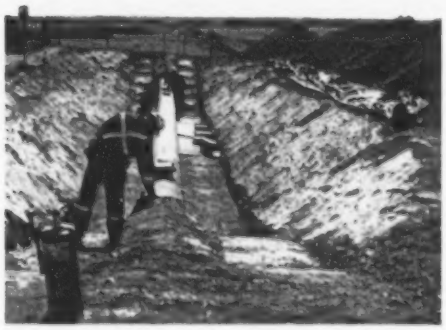


Figure 2.9 provides a breakdown of reported ruptures on NEB-regulated pipelines and their primary causes. The primary cause of ruptures on NEB-regulated pipelines between 1991 and 2008 was corrosion due to cracking and metal loss. Cracking includes hydrogen-induced and mechanical damage delayed cracking, stress corrosion, and corrosion fatigue. Metal loss includes both internal and external corrosion. The category of "Other Causes" includes improper operation, fire and yet to be determined causes.

Some pipelines of specific vintage and of certain construction methods have experienced a higher rupture frequency than others.[1] A number of factors have contributed to the absence of ruptures on new pipelines, including the quality of pipeline coatings and cathodic protection, new construction methods, effective pressure testing and well-developed integrity management programs.



Rupture Cause Comparisons

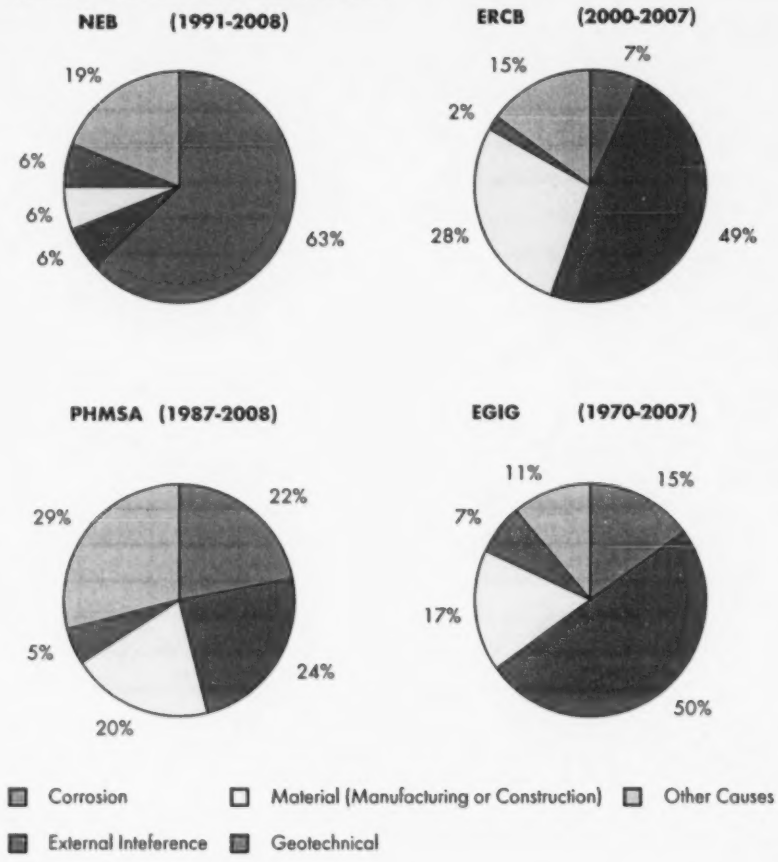
The cause of NEB-regulated pipeline ruptures since 1991 is compared to those reported by the Alberta Energy Resources Conservation Board (ERCB), the United States Pipeline and Hazardous Material Safety Administration (PHMSA) and the European Gas Pipeline Incident Data Group (EGIG) in Figure 2.10. While each organization has different timeframes over which they have examined rupture causes, annual evidence from these organizations suggests that the leading cause of ruptures generally remains constant over time within each organization.

To facilitate a more representative comparison between organizations with different reporting criteria, ruptures caused by metal loss and cracking, as defined by CSA Z662, have been combined and compared to ruptures caused by corrosion. Ruptures brought on by natural causes were compared with geotechnical and other causes. In contrast to the NEB, the leading cause of ruptures reported in other jurisdictions is external interference. Because of differences in pipeline purpose (i.e., gathering, transmission, distribution), exact comparisons are difficult, which may account for differences in

1 Jeglic, F. Analysis of Ruptures and Trends on Major Canadian Pipeline Systems. National Energy Board, Calgary, Canada, 2004.

FIGURE 2.10

Pipeline Rupture Cause Comparison



reported rupture or failure modes. The density of the ERCB-regulated pipeline network coupled with high levels of construction in the Alberta oil and gas sector may account for higher external interference rates in Alberta.

2.6 Pipeline Unauthorized Activities in Rights of Way

Unauthorized activities reported under the NEB Pipeline Crossing Regulations (Part I and Part II) include actions that have the potential to damage a pipeline or that may impede access to a pipeline for the purposes of maintenance or emergency response. As noted previously external interference is a leading cause of ruptures in many jurisdictions.

Unauthorized activities or events considered to be indicators related to pipeline integrity include:

- Movement of vehicles or equipment over pipelines;
- Construction activities with no soil disturbance;
- Construction, landscaping, or grading that results in soil disturbance; and
- Construction, landscaping, or grading, which results in pipeline contact.

TABLE 2.3

Unauthorized Activities on NEB-Regulated Pipeline Rights of Way

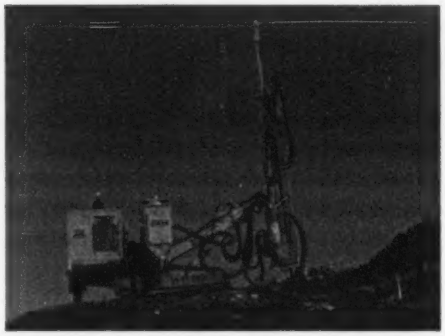
Year	Activities With No Soil Disturbance		Actvities With Soil Disturbance		Pipeline Contacts		Total
	Landowner	Contractor	Landowner	Contractor	Landowner	Contractor	
2000	5	0	12	26	0	2	45
2001	7	0	14	27	1	0	49
2002	2	0	7	13	0	1	23
2003	9	4	7	30	2	0	52
2004	4	2	12	33	1	1	53
2005	11	2	20	37	0	1	71
2006	6	4	23	32	0	1	66
2007	8	9	28	21	0	2	68
2008	7	3	65	51	0	0	126
Average	6.6	2.7	20.9	30.0	0.4	0.9	61.4

The total number of unauthorized activities in rights of way between 2005 and 2007 had stabilized at approximately 70 per year; however this number increased in 2008 to 126. This is significantly greater than the nine-year average of 61 per year shown in Table 2.3. Note that increasing urban encroachment on pipeline rights of way is a growing concern and may result in an increased number of unauthorized activities along rights of way.

The number of pipeline contacts remains consistently low, ranging from one to two per year. In 2008, there were no reported unauthorized pipeline contacts. Overall contacts constitute less than 5 percent of the total number of unauthorized activities.

PIPELINE ENVIRONMENTAL PERFORMANCE

NEB regulated companies are required to develop environmental emergency response programs addressing potential upset conditions on their systems. These programs would take into consideration the magnitude of facilities and activities that could potentially be impacted during a liquid hydrocarbon release. A release of this nature has the potential to affect human health, harm wildlife, aquatic life and vegetation as well as affect surface and groundwater quality by contaminating these water supplies for present and future uses.



As a performance indicator, any pipeline failure (including ruptures and leaks) resulting in a release of liquid having a volume greater than 1.5 m3 (1 500 L) must be reported pursuant to the NEB OPR-99; however, data regarding liquid releases of volumes less than 1.5 m3 were requested from NEB-regulated companies under the SPI initiative.

In the case of a spill, leak or major release, the Board's role is to ensure that the companies responsible conduct Phase I, II and III Environmental Site Assessments and provide a Remedial Action Plan for cleanup of contamination at the spill site and eventual restoration to original or equivalent capability. The NEB continues to monitor situations where remediation of soil, surface water or groundwater contamination is ongoing.

3.1 Liquid Pipebody Releases

Pipebody releases describe any leak which originates from the body of the pipe including cracks and pinholes. Pipebody liquid releases reportable under NEB OPR-99 are shown in Table 3.1.

NEB-regulated pipelines experienced very few pipebody liquid releases between 2000 and 2008. As highlighted in Table 3.1, there were no liquid releases in 2000, 2003, 2004 or 2008 from NEB-regulated pipelines. Overall, NEB-regulated liquid pipelines have a nine year average of 0.1

TABLE 3.1

Pipebody Liquid Releases

Year	Number of Liquid Pipe Body Releases >1.5 m^3	Volume of Liquid Pipe Body Releases (m^3)
2000	0	0
2001	2	3650
2002	2	52
2003	0	0
2004	0	0
2005	2	254
2006	4	39
2007	4	1182
2008	0	0

pipebody liquid releases per 1 000 kilometres or one release per 10 000 kilometres of pipe. However there were four liquid pipebody releases in 2007, two of which released significant volumes of hydrocarbon. One release affected a marine environment and public property. The release site has been cleaned up and immediate risks to the public and the environment removed. In addition, the Board is monitoring the ongoing remediation and company management of residual contamination. The second release occurred in a prairie wetland and the contaminated area has been remediated to NEB standards at this site as well.

3.2 Liquid Release Frequency Comparisons

The liquid release frequency for NEB-regulated liquid pipelines was compared to that of reference organizations in Figure 3.1. It is important to consider that the reporting criteria for liquid releases may vary slightly from organization to organization as shown in Table 3.2. In an effort to make the comparison more meaningful, data from PHMSA and CONCAWE have been sorted to consider only incidents which meet NEB reporting criteria.

NEB-regulated pipelines have had fewer pipebody liquid releases than in other jurisdictions in every year prior to 2006. This may be due, in part, to the higher frequency of pipeline contacts by third parties experienced by PHMSA. In 2008, NEB-regulated companies did not report any pipebody liquid releases. CONCAWE data is not yet available for the 2008 calendar year.

FIGURE 3.1

Pipebody Liquid Release Frequency

Number of Releases per 1 000 km

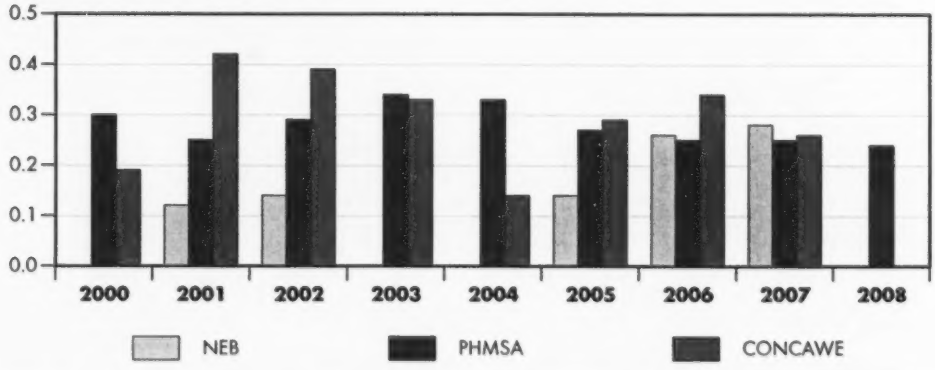


TABLE 3.2

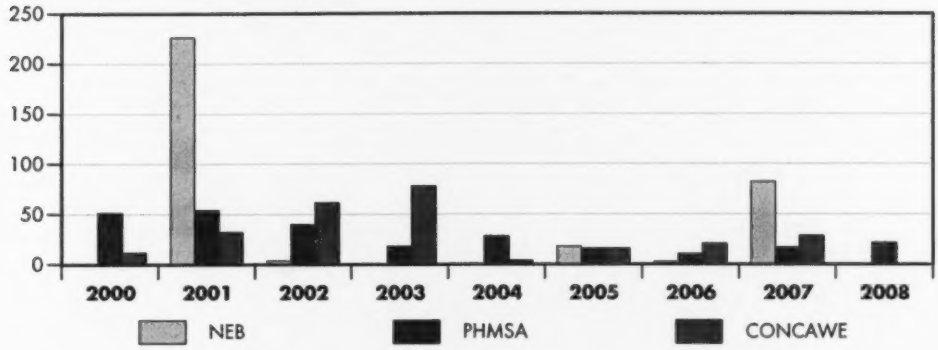
Liquid Release Reporting Criteria

Organization	Liquid Release Reporting Requirements
NEB	Any unintended or uncontained release of liquid hydrocarbons in excess of 1.5 cubic metres.
PHMSA	Loss of 8 or more cubic metres or where property damage costs exceed $50,000 USD, **or** after 7 February 2002: a release of 5 gallons (19 litres) or more.
CONCAWE	The minimum spill size has been set at 1 m^3 for reporting purposes unless there are exceptional serious safety/environmental consequences as a result of a 1 m^3 spill.

FIGURE 3.2

Pipebody Liquid Release Volume

m^3 of liquid released per 1 000 km



3.3 Liquid Release Volume Comparisons

A single large rupture or break can have a significant impact on the liquid release volume performance indicator. This is particularly evident in Figure 3.2 where in 2001, large events caused this indicator's upper range to be in excess of 200 m3 per 1 000 km of liquid pipelines. As previously mentioned, NEB facilities had two major releases from ruptures that increased the reported volume for 2007. Again note that CONCAWE data is not yet available for 2008.

3.4 Operational Liquid Leaks

Operational leaks on liquid pipelines are hydrocarbon product leaks associated with pipeline operations and which originate from pipeline components such as flanges, valves, pumps or storage tanks. These leaks are usually contained within fenced pipeline facilities (as well as secondary containment when required) and exclude leaks from pipebodies. Most of these leaks are less than 1.5 m^3 in volume as shown in Table 3.3.

A large liquid leak (1 075 m^3) occurred in 2002 at a pump station and a large leak (950 m3) occurred in 2005 at an oil terminal. This resulted in a high total leak volume for those years. On average, approximately 40 leaks per year are reported on NEB-regulated pipeline systems. Much like pipebody releases, a single large leak from pipeline components can have a significant impact on total annual leak volume. No reference organizations publish a liquid leak frequency comparable to that of the NEB.

The frequency of liquid leaks from non-pipebody sources has a nine year average of approximately three leaks per

TABLE 3.3

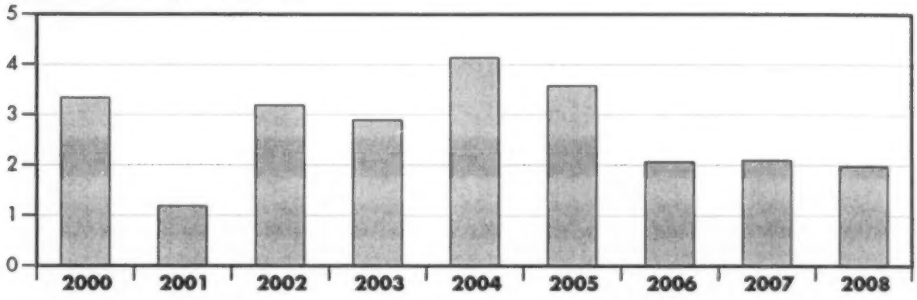
Pipeline Operational Leaks

Year	Number of Leaks ≤1.5 m^3	Number of Leaks >1.5 m^3	Total Number of Leaks	Total Leak Volume (m^3)
2000	42	2	44	102
2001	15	4	19	279
2002	38	9	47	1184
2003	43	1	44	13
2004	57	5	62	34
2005	48	3	51	1269
2006	25	7	32	322
2007	26	4	30	129
2008	25	6	31	186

FIGURE 3.3

Pipeline Operational Liquid Leak Frequency

Number of leaks per 1 000 km



1 000 km of pipeline. Figure 3.3 shows that the frequency in 2008 has remained consistent with values reported in 2006 and 2007.

3.5 Non-Pipeline Liquid Spills

Liquid spills are associated with pipeline construction, maintenance and operations on both liquid and gas pipelines. These spills include small volumes of hydraulic oil, lubrication oil, valve operator fluids or equipment fuels, but exclude product leaks from liquid pipeline systems. The number and volume of these spills are shown in Table 3.4.

TABLE 3.4

Non-Pipeline Liquid Spills

Year	Number of Spills ≤1.5m³	Number of Spills >1.5m³	Total Number of Spills	Total Spill Volume (m³)
2000	227	0	227	16
2001	28	1	29	3
2002	25	0	25	2
2003	48	1	49	5
2004	64	1	65	4
2005	47	1	48	12
2006	125	0	125	3
2007	36	0	36	2
2008	16	3	19	15

High levels of construction activity in 2000 resulted in a significant number of reported spills. Overall, the average volume per spill is small, with the nine year average being 0.2 m^3 per spill. The number of spills was lower than average for 2008 with only 19 spills; however, reported volume saw an increase to 15 m^3.

3.6 Gas Releases and Operational Gas Leaks

Gas releases are the result of pipebody failures and include both ruptures and leaks. Operational gas leaks occur through equipment, including venting from valves and seepage at flanges through gaskets.

The data presented in Table 3.6 does not include the intentional release of gas such as planned blowdowns. All unplanned, unintended or uncontrolled gas leaks from NEB-regulated pipelines must be reported as there is no minimum reportable volume.

3.7 Gas Release Frequency Comparison

A comparison is made between the frequency of gas releases from NEB-regulated gas pipelines and EGIG regulated gas pipelines in Figure 3.4. The gas release reporting criteria for EGIG and the NEB are summarized in Table 3.5. Note that EGIG data is not yet available for 2008.

The nine-year average of the gas pipeline release frequency for NEB-regulated pipelines was approximately 0.09 releases per 1 000 km or approximately one gas release per 11 000 km. NEB gas release frequencies were lower than the EGIG frequencies until 2007. The NEB-regulated pipeline release frequency for 2008 was 0.24 per 1 000 km, a two-fold increase over the previous year.

TABLE 3.5

Pipeline Gas Releases and Leaks

Year	Pipe Body Gas Releases	Operational Pipeline Gas Leaks
2000	1	24
2001	1	23
2002	2	11
2003	0	11
2004	4	19
2005	4	18
2006	1	22
2007	3	58
2008	6	30

FIGURE 3.4

Pipebody Gas Release Frequency

Number of Releases per 1 000 km

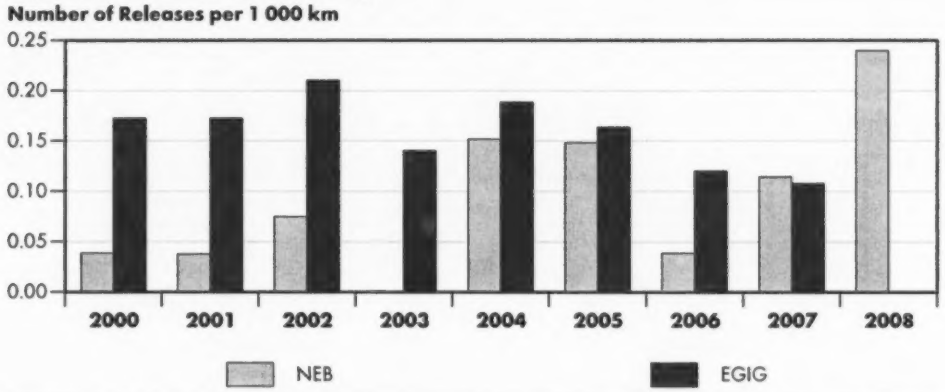


TABLE 3.6

Gas Release Reporting Criteria

Organization	Gas Release Reporting Requirements
NEB	Any unintended or uncontrolled release of natural gas.
EGIG	Any unintentional release of gas which occurs on an onshore pipeline operating at greater than 1500 kPa outside of the fenced boundaries of installations and excluding all components except the pipe.

3.8 Operational Gas Leak Frequency

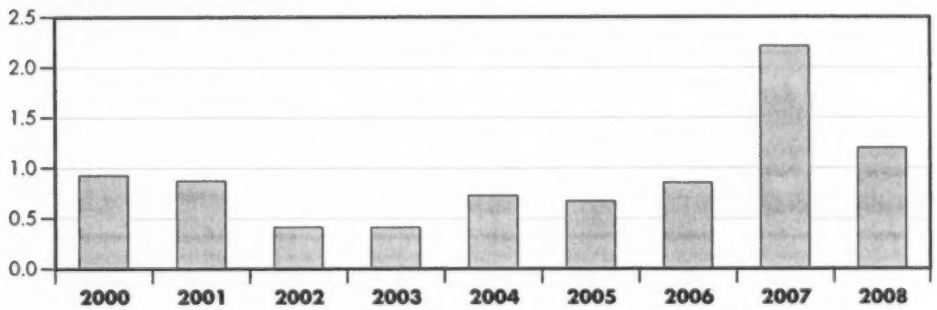
As with liquid leaks, an operational gas leak is any product leak associated with pipeline operations and which originates from pipeline components such as flanges, valves, compressors or storage tanks. At a frequency of approximately 1.2 leaks per 1 000 km, operational gas leaks on NEB-regulated gas pipelines occur about five times more often than pipebody gas releases.

Due to the differences in reporting requirements for gas leaks between the NEB and other agencies, no comparison is made for operational leaks. The frequency of operational gas leaks on NEB-regulated gas pipelines is shown in Figure 3.5.

FIGURE 3.5

Operation Gas Leak Frequency

Number of leaks per 1 000 km



NEB-REGULATED PIPELINE PERFORMANCE INDICATOR SUMMARY

In summary, reporting by pipeline companies for 2008 showed that several performance indicators have improved since 2007 Table 4.1 shows a summary of the previous two years of performance indicators. In particular, injury frequencies for both contractors and employees have seen a marked

TABLE 4.1

NEB-Regulated Pipeline Performance Indicator Summary

Performance Indicator	2007	2008	Historical Average 2000-2008
Number of Fatalities (employee, contractor and third party)	0	2	0.0
Worker Injury Frequency (injuries per 200 000 worker hours)	1.9	1.0	1.1
Contractor Injury Frequency (injuries per 200 000 contractor hours)	2.3	1.2	2.2
Employee Injury Frequency (injuries per 200 000 employee hours)	1.5	0.7	0.7
Liquid Pipeline Worker Injury Frequency (injuries per 200 000 worker hours)	1.6	1.4	1.5
Gas Pipeline Worker Injury Frequency (injuries per 200 000 worker hours)	2.2	0.6	1.1
Total Number of Pipeline Ruptures	2	0	1.0
Total Number of Pipeline Contacts	2	0	1.5
Pipe Body Liquid Release Frequency (number of liquid releases per 1 000 km)	0.3	0.0	0.1
Pipe Body Liquid Release Volume Frequency (m^3 of liquid released per 1 000 km)	82.3	0.0	41.5
Number of Operational Liquid Leaks	30	31	41.1
Operational Liquid Leak Frequency (number of leaks per 1 000 km)	2.1	2	2.8
Pipe Body Gas Release Frequency (number of gas releases per 1 000 km gas pipelines)	0.1	0.2	0.1
Number of Operational Gas Leaks (on gas pipelines)	58	30	23.3
Operational Gas Leak Frequency (number of leaks per 1 000 km gas pipelines)	2.2	1.2	0.9
Number of Non-pipeline Spills (construction and maintenance liquid spills)	36	19	75.5
Total Number of Incidents (reportable under OPR-99)	49	56	40.9

decrease in 2008, returning to levels comparable to those reported in 2005 and 2006. However, two fatalities reported in 2008 are a cause for major concern.

From an environmental protection perspective, no pipebody liquid releases were reported and the number of non-pipeline spills and liquid leaks remained stable.

LOOKING AHEAD

Protecting the environment and the safety of the public and the people who build and operate pipelines is of paramount importance to the NEB. Injury frequencies, incident trends and other indicators help the NEB to identify where improvement is needed.

In 2009, the NEB took over jurisdiction of TransCanada's Nova Gas Transmission system, resulting in a 50 per cent increase in the overall length of pipeline under the Board's jurisdiction. In order to ensure that this extensive system meets federal safety legislation, a third-party audit and a series of safety inspections to assess levels of compliance were carried out. Also in 2009, three ruptures were reported on NEB-regulated pipelines, these ruptures are currently under active investigation.

Due to the Board's ongoing concern about major incidents and incident frequencies along its regulated pipeline an initiative has been launched to approach incidents from a management systems perspective and to work to ensure that possible systemic issues are dealt with proactively.

The Board is committed to finding ways to improve the safety performance of the pipeline industry. The NEB's goal is to reduce the number of incidents and injuries to as low a level as possible. In 2008, the NEB continued to employ a risk-based approach to determine the degree of regulatory oversight required for its regulated companies. This approach allows the NEB to focus compliance resources on companies that will benefit the most from regulatory oversight; as a result, NEB staff conducted 239 compliance activities in 2009.

In May 2009, the NEB held a public forum to address a wide variety of topics ranging from regulatory reform to pipeline safety. The forum included a panel discussion on pipeline safety with representatives from contractors, industry and pipeline regulators. This is one example of the ongoing dialogue on safety that the NEB conducts with industry. For more information, on current safety performance indicators, please click on "Safety Performance Indicators" under the safety tab on the National Energy Board website.

Continuous improvement will ensure that pipelines remain the safest mode of energy transportation in Canada. The safety of the facilities, the men and women who build and operate them and the public is, and will remain, the Board's primary goal.

PIPELINE PERFORMANCE INDICATOR DATA

Performance Indicator data for the period 1 January 2008 to 31 December 2008 was submitted voluntarily to the NEB from companies owning or operating approximately 87% of the total length of pipelines regulated by the NEB under the *National Energy Board Act*. Companies typically as provided by respondents, report on all NEB-regulated pipelines systems that they own. The following tables provide raw data from those companies that reported on pipeline length worker hours and injuries. In addition, reference organization data on pipeline lengths and injury frequency is listed here.

TABLE A1.1

Companies Reporting Performance Indicator Data for 2008

Alliance Pipeline Ltd.	Kinder Morgan Canada Inc.
AltaGas Ltd.	Kinder Morgan Cochin ULC
ATCO Midstream	Maritimes & Northeast Pipeline
BP Canada Energy Company	Montreal Pipe Line Limited
Canadian-Montana Pipe Line Corporation	Nexen Inc.
Canadian Natural Resources Limited	Penn West Petroleum Ltd.
Enbridge Pipelines (NW) Inc.	Spectra Energy Transmission
Enbridge Pipelines (Westspur) Inc.	St. Clair Pipelines Management Inc.
Enbridge Pipelines Inc.	TransCanada PipeLines Limited
EnCana Corporation	Trans-Northern Pipelines Inc.
Enerplus Resources Fund	Union Gas Limited
Harvest Operations Corp	Vector Pipeline Limited Partnership
Kaiser Exploration Ltd.	

TABLE A1.2

NEB-Regulated Pipeline Lengths

Year	Number of Kilometres Reported Under Voluntary Initiative	Total Kilometres Regulated
2000	39 193	42 919
2001	42 674	42 968
2002	41 555	43 124
2003	42 189	43 252
2004	41 386	43 371
2005	41 270	43 440
2006	41 454	43 530
2007	40 642	43 734
2008	40 760	46 732

TABLE A1.3

Pipeline Contractor and Employee Injury Frequency Raw Data

Year	Contractor Hours	Employee Hours	Contractor Injuries	Employee Injuries
2000	6 255 390	7 034 954	55	6
2001	1 606 271	4 827 678	40	18
2002	1 357 577	5 103 983	13	4
2003	788 466	4 869 253	12	16
2004	1 573 743	4 722 044	9	12
2005	1 218 350	4 925 620	7	15
2006	2 140 650	3 811 330	17	29
2007	2 918 420	2 850 195	33	22
2008	12 432 795	6 745 368	72	23

TABLE A1.4

Gas and Liquid Pipeline Worker Hours

Year	Liquid Pipeline	Gas Pipeline	Total
2000	1 124 735	12 165 609	13 290 344
2001	1 808 947	4 625 003	6 433 950
2002	1 822 637	4 638 923	6 461 560
2003	1 655 670	4 002 049	5 657 719
2004	1 615 406	4 680 381	6 295 787
2005	1 398 649	4 745 321	6 143 969
2006	1 625 244	4 326 736	5 951 979
2007	2 707 357	3 061 257	5 768 614
2008	9 949 629	9 228 533	19 178 162

TABLE A1.5

Reference Organization Pipeline Lengths

Year	Organization	Kilometres of Gas Pipeline	Kilometres of Hydrocarbon Liquid Pipeline	Total Reported Kilometres
2000	NEB	25974	13219	39193
2000	PHMSA	469946	257440	727386
2000	CONCAWE	0	30800	30800
2000	EGIG	110236	0	110236
2000	EUB	229034	16410	245444
2001	NEB	26509	16165	42674
2001	PHMSA	455862	255437	711299
2001	CONCAWE	0	35575	35575
2001	EGIG	110236	0	110236
2001	EUB	245466	16818	262284
2002	NEB	26752	14803	41555
2002	PHMSA	475538	258672	734210
2002	CONCAWE	0	35592	35592
2002	EGIG	109524	0	109524
2002	EUB	255032	17118	272150
2003	NEB	26943	15245	42189
2003	PHMSA	472877	255219	728096
2003	CONCAWE	0	36422	36422
2003	EGIG	114285	0	114285
2003	EUB	268549	17391	285940
2004	NEB	26374	15012	41386
2004	PHMSA	431965	253411	685376
2004	CONCAWE	0	35383	35383
2004	EGIG	122168	0	122168
2004	EUB	288388	17793	306181
2005	NEB	27002	14269	41270
2005	PHMSA	471693	252606	724299
2005	CONCAWE	0	34826	34826
2005	EGIG	122500	0	122500
2005	EUB	305274	18260	323534
2006	NEB	25888	15566	41454
2006	PHMSA	469990	252379	722370
2006	CONCAWE	0	35390	35390
2006	EGIG	125000	0	125000
2006	EUB	321944	18142	340086

TABLE A1.5

Reference Organization Pipeline Lengths – Continued

Year	Organization	Kilometres of Gas Pipeline	Kilometres of Hydrocarbon Liquid Pipeline	Total Reported Kilometres
2007	NEB	26275	14368	40642
2007	PHMSA	471918	258850	730768
2007	CONCAWE	0	34700	34700
2007	EGIG	129719	0	129719
2007	EUB	331891	18568	350459
2008	NEB	25046	15715	40760
2008	PHMSA	472314	263003	735317
2008	CONCAWE	not available	not available	not available
2008	EGIG	not available	not available	not available
2008	EUB	not available	not available	not available

TABLE A1.6

Reference Organization Injury Frequency Data

Year	Source*	Contractor Injury Frequency	Employee Injury Frequency	Worker Injury Frequency
2000	NEB	1.76	0.17	0.92
2000	HRSDC	not available	0.51	not available
2000	CAPP	3.13	1.05	2.49
2001	NEB	4.98	0.75	1.80
2001	HRSDC	not available	0.56	not available
2001	CAPP	2.61	0.89	2.06
2002	NEB	1.92	0.16	0.53
2002	HRSDC	not available	0.30	not available
2002	CAPP	1.86	1.02	1.64
2003	NEB	3.04	0.66	0.99
2003	HRSDC	not available	0.33	not available
2003	CAPP	2.15	1.34	1.80
2004	NEB	1.14	0.51	0.67
2004	HRSDC	not available	0.42	not available
2004	CAPP	1.90	1.00	1.64
2005	NEB	1.15	0.61	0.72
2005	HRSDC	not available	0.32	not available
2005	CAPP	1.74	0.95	1.52
2006	NEB	1.59	1.52	1.55
2006	HRSDC	not available	0.34	not available
2006	CAPP	1.74	0.83	1.48
2007	NEB	2.26	1.54	1.91
2007	HRSDC	not available	0.32	not available
2007	CAPP	1.31	0.80	1.15
2008	NEB	1.16	0.68	0.99
2008	HRSDC	not available	not available	not available
2008	CAPP	1.25	0.64	1.08

* CAPP data is for total recordable injury frequency and includes fatalities and medical treatment cases, which are not included in NEB data.

Data Sources

2009 CAPP Stewardship Report, published by the Canadian Association of Petroleum Producer in January 2010.

Performance of European cross-country oil pipelines – Statistical summary of reported spillages in 2007 since 1971, CONCAWE Report no. 10/09, published November 2009.

7th EGIG Report, 1970-2007 Gas Pipeline Incidents, Document No. EGIG 08.TV-B.0502 published in December 2008.

ERCB Provincial Surveillance and Compliance Summary 2007, ST99-2008, published June 2008.

Occupational Injuries Among Canadian Employers Under Federal Jurisdiction, 2002–2007. Published by HRSDC.

All PHMSA data retrieved from data files available on http://phmsa.dot.gov.

Information provided annually to the NEB through the Safety Performance Indicators Initiative.